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DEVICE SPECIFICATION FOR

# TFT-LCD Module

MODEL No.

# LQ0DZA1003

## RECORDS OF REVISION

LQ0DZA1003

## 1. Application

This specification applies to the color 18.1 SXGA TFT-LCD module LQ0DZA1003.

The device listed in these specification sheets was designed and manufactured for use in OA equipment.

In case of using the device for applications such as control and safety equipment for transportation(aircraft, trains, automobiles, etc. ), rescue and security equipment and various safety related equipment which require higher reliability and safety, take into consideration that appropriate measures such as fail-safe functions and redundant system design should be taken.

Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, telecommunication equipment(trunk lines), nuclear power control equipment and medical or other equipment for life support.

## 2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, control circuit, power supply circuit and a back light unit. Graphics and texts can be displayed on a  $1280 \times 3 \times 1024$  dots panel with about 16 million colors (8 bit) by supplying 48 bit data signals(8bit  $\times$  2pixel  $\times$  RGB) or 96 bit data signals(8bit  $\times$  4pixel  $\times$  RGB), two display enable signals, two dot clock signals, +5V DC and +15V DC supply voltages for TFT-LCD panel driving and supply voltage for back light.

### 3. Mechanical Specifications

| Parameter                  | Specifications                 | Unit  |
|----------------------------|--------------------------------|-------|
| Display size               | 46 (Diagonal)                  | cm    |
|                            | 18.1 (Diagonal)                | Inch  |
| Active area                | 359.0 (H) × 287.2 (V)          | Mm    |
| Pixel format               | 1280 (H) × 1024 (V)            | Pixel |
|                            | (1 pixel = R + G + B dots)     |       |
| Pixel pitch                | 0.2805 (H) × 0.2805 (V)        | Mm    |
| Pixel configuration        | R,G,B vertical stripe          |       |
| Display mode               | Normally Black                 |       |
| Unit outline dimensions *1 | 414 (W) × 335 (H) × 24 (D)     | Mm    |
| Mass                       | 3280 ± 80                      | g     |
| Surface treatment          | Anti-glare and hard-coating 2H |       |

\*1. Note: excluding back light cables.

The thickness of module (D) doesn't contain the projection.

Outline dimensions are shown in Fig.1.

#### 4. Input Terminals

##### 4-1. TFT-LCD panel driving

CN1 (Interface signals and +5VDC / +15VDC power supply)

Using connector : SD-53493-1400 (Molex-Japan Co., Ltd.)

Mating connector : SD-52777-1400 (Molex-Japan Co., Ltd.)

| Pin No. | Symbol | Function                    | Remark |
|---------|--------|-----------------------------|--------|
| 1       | GND    | Gnd                         |        |
| 2       | GND    | Gnd                         |        |
| 3       | GND    | Gnd                         |        |
| 4       | GND    | Gnd                         |        |
| 5       | RC7    | RED odd data signal (MSB)   |        |
| 6       | RA7    | RED odd data signal (MSB)   |        |
| 7       | RC6    | RED odd data signal         |        |
| 8       | RA6    | RED odd data signal         |        |
| 9       | RC5    | RED odd data signal         |        |
| 10      | RA5    | RED odd data signal         |        |
| 11      | RC4    | RED odd data signal         |        |
| 12      | RA4    | RED odd data signal         |        |
| 13      | Vcc    | +5V power supply            |        |
| 14      | Vcc    | +5V power supply            |        |
| 15      | RC3    | RED odd data signal         |        |
| 16      | RA3    | RED odd data signal         |        |
| 17      | RC2    | RED odd data signal         |        |
| 18      | RA2    | RED odd data signal         |        |
| 19      | RC1    | RED odd data signal         |        |
| 20      | RA1    | RED odd data signal         |        |
| 21      | RC0    | RED odd data signal (LSB)   |        |
| 22      | RA0    | RED odd data signal (LSB)   |        |
| 23      | GND    | Gnd                         |        |
| 24      | GND    | Gnd                         |        |
| 25      | GC7    | GREEN odd data signal (MSB) |        |
| 26      | GA7    | GREEN odd data signal (MSB) |        |
| 27      | GC6    | GREEN odd data signal       |        |
| 28      | GA6    | GREEN odd data signal       |        |
| 29      | GC5    | GREEN odd data signal       |        |
| 30      | GA5    | GREEN odd data signal       |        |
| 31      | GC4    | GREEN odd data signal       |        |
| 32      | GA4    | GREEN odd data signal       |        |
| 33      | Vcc    | +5V power supply            |        |
| 34      | Vcc    | +5V power supply            |        |
| 35      | GC3    | GREEN odd data signal       |        |
| 36      | GA3    | GREEN odd data signal       |        |
| 37      | GC2    | GREEN odd data signal       |        |
| 38      | GA2    | GREEN odd data signal       |        |
| 39      | GC1    | GREEN odd data signal       |        |
| 40      | GA1    | GREEN odd data signal       |        |
| 41      | GC0    | GREEN odd data signal (LSB) |        |
| 42      | GA0    | GREEN odd data signal (LSB) |        |
| 43      | GND    | Gnd                         |        |
| 44      | GND    | Gnd                         |        |
| 45      | BC7    | BLUE odd data signal (MSB)  |        |
| 46      | BA7    | BLUE odd data signal (MSB)  |        |
| 47      | BC6    | BLUE odd data signal        |        |
| 48      | BA6    | BLUE odd data signal        |        |

|     |      |  |  |
|-----|------|--|--|
| 49  | BC5  | BLUE odd data signal                                       |  |
| 50  | BA5  | BLUE odd data signal                                       |  |
| 51  | BC4  | BLUE odd data signal                                       |  |
| 52  | BA4  | BLUE odd data signal                                       |  |
| 53  | Vcc  | +5V power supply   |  |
| 54  | Vcc  | +5V power supply   |  |
| 55  | BC3  | BLUE odd data signal                                       |  |
| 56  | BA3  | BLUE odd data signal                                       |  |
| 57  | BC2  | BLUE odd data signal                                       |  |
| 58  | BA2  | BLUE odd data signal                                       |  |
| 59  | BC1  | BLUE odd data signal                                       |  |
| 60  | BA1  | BLUE odd data signal                                       |  |
| 61  | BC0  | BLUE odd data signal (LSB)                                 |  |
| 62  | BA0  | BLUE odd data signal (LSB)                                 |  |
| 63  | GND  | Gnd  |  |
| 64  | GND  | Gnd  |  |
| 65  | DEB  | Data enable signal (Signal to settle the display position) |  |
| 66  | DEA  | Data enable signal (Signal to settle the display position) |  |
| 67  | Vcc  | +5V power supply   |  |
| 68  | Vcc  | +5V power supply   |  |
| 69  | CLKB | Sampling clock (for even data signal)                      |  |
| 70  | CLKA | Sampling clock (for odd data signal)                       |  |
| 71  | GND  | Gnd  |  |
| 72  | GND  | Gnd  |  |
| 73  | RD7  | RED even data signal (MSB)                                 |  |
| 74  | RB7  | RED even data signal (MSB)                                 |  |
| 75  | RD6  | RED even data signal                                       |  |
| 76  | RB6  | RED even data signal                                       |  |
| 77  | RD5  | RED even data signal                                       |  |
| 78  | RB5  | RED even data signal                                       |  |
| 79  | RD4  | RED even data signal                                       |  |
| 80  | RB4  | RED even data signal                                       |  |
| 81  | Vcc  | +5V power supply   |  |
| 82  | Vcc  | +5V power supply   |  |
| 83  | RD3  | RED even data signal                                       |  |
| 84  | RB3  | RED even data signal                                       |  |
| 85  | RD2  | RED even data signal                                       |  |
| 86  | RB2  | RED even data signal                                       |  |
| 87  | RD1  | RED even data signal                                       |  |
| 88  | RB1  | RED even data signal                                       |  |
| 89  | RD0  | RED even data signal (LSB)                                 |  |
| 90  | RB0  | RED even data signal (LSB)                                 |  |
| 91  | GND  | Gnd  |  |
| 92  | GND  | Gnd  |  |
| 93  | GD7  | GREEN even data signal (MSB)                               |  |
| 94  | GB7  | GREEN even data signal (MSB)                               |  |
| 95  | GD6  | GREEN even data signal                                     |  |
| 96  | GB6  | GREEN even data signal                                     |  |
| 97  | GD5  | GREEN even data signal                                     |  |
| 98  | GB5  | GREEN even data signal                                     |  |
| 99  | GD4  | GREEN even data signal                                     |  |
| 100 | GB4  | GREEN even data signal                                     |  |
| 101 | Vcc  | +5V power supply   |  |
| 102 | Vcc  | +5V power supply   |  |

|     |      |                                 |        |
|-----|------|---------------------------------|--------|
| 103 | GD3  | GREEN even data signal          |        |
| 104 | GB3  | GREEN even data signal          |        |
| 105 | GD2  | GREEN even data signal          |        |
| 106 | GB2  | GREEN even data signal          |        |
| 107 | GD1  | GREEN even data signal          |        |
| 108 | GB1  | GREEN even data signal          |        |
| 109 | GD0  | GREEN even data signal (LSB)    |        |
| 110 | GB0  | GREEN even data signal (LSB)    |        |
| 111 | GND  | Gnd                             |        |
| 112 | GND  | Gnd                             |        |
| 113 | BD7  | BLUE even data signal (MSB)     |        |
| 114 | BB7  | BLUE even data signal (MSB)     |        |
| 115 | BD6  | BLUE even data signal           |        |
| 116 | BB6  | BLUE even data signal           |        |
| 117 | BD5  | BLUE even data signal           |        |
| 118 | BB5  | BLUE even data signal           |        |
| 119 | BD4  | BLUE even data signal           |        |
| 120 | BB4  | BLUE even data signal           |        |
| 121 | Vcc  | +5V power supply                |        |
| 122 | Vcc  | +5V power supply                |        |
| 123 | BD3  | BLUE even data signal           |        |
| 124 | BB3  | BLUE even data signal           |        |
| 125 | BD2  | BLUE even data signal           |        |
| 126 | BB2  | BLUE even data signal           |        |
| 127 | BD1  | BLUE even data signal           |        |
| 128 | BB1  | BLUE even data signal           |        |
| 129 | BD0  | BLUE even data signal (LSB)     |        |
| 130 | BB0  | BLUE even data signal (LSB)     |        |
| 131 | GND  | Gnd                             |        |
| 132 | GND  | Gnd                             |        |
| 133 | BLON | Back Light Status * 1           | Output |
| 134 | MODE | H : 2pixel mode L : 4pixel mode |        |
| 135 | GND  | Gnd                             |        |
| 136 | GND  | Gnd                             |        |
| 137 | Vdd  | +15V power supply               |        |
| 138 | Vdd  | +15V power supply               |        |
| 139 | Vdd  | +15V power supply               |        |
| 140 | Vdd  | +15V power supply               |        |

\* 1 When Vcc and Vdd are turned on, the output signal BLON goes to high typically 212 milliseconds later. The maximum output current is 1 milliamper.

#### 4-2. Back light driving

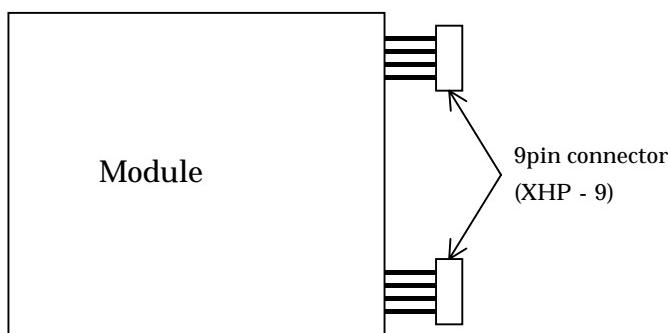
CN 2, 3

The module-side connector : XHP - 9 (JST)

The user-side connector : S9B - XH - A (JST)

| Pin no. | Symbol     | Function                                    |
|---------|------------|---|
| 1       | $V_{HIGH}$ | Power supply for lamp A (High voltage side) |
| 2       | NC         | This is electrically opened.                |
| 3       | NC         | This is electrically opened.                |
| 4       | $V_{HIGH}$ | Power supply for lamp B (High voltage side) |
| 5       | NC         | This is electrically opened.                |
| 6       | NC         | This is electrically opened.                |
| 7       | $V_{LOW}$  | Power supply for lamp B (Low voltage side)  |
| 8       | NC         | This is electrically opened.                |
| 9       | $V_{LOW}$  | Power supply for lamp A (Low voltage side)  |

The pair of pin 1 and pin 9 is for the same CCFT lamp. The pair of pin 4 and 7 is in the same way.



#### 5. Absolute Maximum Ratings

| Parameter                       | Symbol    | Condition | Ratings      | Unit | Remark  |
|---------------------------------|-----------|-----------|--------------|------|---------|
| Input voltage                   | $V_I$     | Ta=25     | - 0.3 ~ +5.5 | V    | 【Note1】 |
| +5.0V supply voltage            | $V_{cc}$  | Ta=25     | 0 ~ + 6      | V    |         |
| +15.0V supply voltage           | $V_{dd}$  | Ta=25     | 0 ~ + 17     | V    |         |
| Storage temperature             | $T_{stg}$ | -         | - 25 ~ + 60  |      | 【Note2】 |
| Operating temperature (Ambient) | $T_{opa}$ | -         | 0 ~ + 50     |      |         |

【Note1】 CLKA, CLKB, RA0 ~ RA7, GA0 ~ GA7, BA0 ~ BA7, RB0 ~ RB7, GB0 ~ GB7, BB0 ~ BB7,

RC0 ~ RC7, GC0 ~ GC7, BC0 ~ BC7, RD0 ~ RD7, GD0 ~ GD7, BD0 ~ BD7, DEA, DEB, MODE

【Note2】 Humidity : 95%RH Max. ( Ta 40 )

Maximum wet-bulb temperature at 39 or less. ( Ta>40 )

No condensation.

## 6. Electrical Characteristics

## 6-1. TFT-LCD panel driving

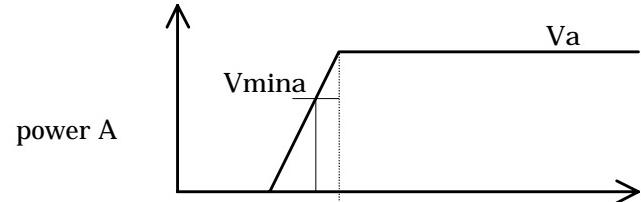
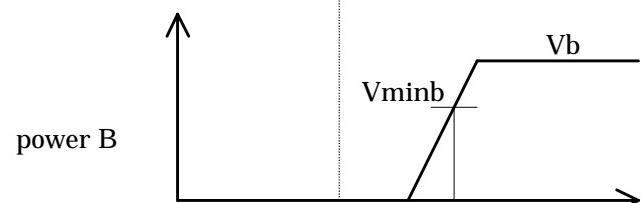
 $T_a = 25$ 

| Parameter                       |                     | Symbol             | Min.   | Typ.  | Max.  | Unit  | Remark                         |
|---------------------------------|---------------------|--------------------|--------|-------|-------|-------|--------------------------------|
| Vcc                             | Supply voltage      | Vcc                | +4.75  | +5.0  | +5.25 | V     | 【Note1】                        |
|                                 | Current dissipation | Icc                | -      | 130   | 500   | mA    | 【Note2】                        |
| Vdd                             | Supply voltage      | Vdd                | +14.15 | +15.0 | +15.8 | V     | 【Note1】                        |
|                                 | Current dissipation | Idd                | -      | 300   | 600   | mA    | 【Note2】                        |
| Permissive input ripple voltage |                     | V <sub>RFVcc</sub> | -      | -     | 100   | mVp-p | V <sub>cc</sub> =+5.0V         |
|                                 |                     | V <sub>RFVdd</sub> | -      | -     | 300   | mVp-p |                                |
| Input voltage (Low)             |                     | V <sub>IL</sub>    | 0      | -     | +0.6  | V     | 【Note3】                        |
| Input voltage (High)            |                     | V <sub>IH</sub>    | +2.7   | -     | +3.3  | V     | 【Note3】                        |
| Input current (Low)             |                     | I <sub>IL</sub>    | -      | -     | 10    | μA    | V <sub>I</sub> =GND<br>【Note3】 |
| Input current (High)            |                     | I <sub>IH</sub>    | -      | -     | 10    | μA    | V <sub>I</sub> =Vcc<br>【Note3】 |
| Output voltage (Low)            |                     | V <sub>OL</sub>    | -      | -     | +0.4  | V     | I <sub>OL</sub> =1mA           |
| Output voltage (High)           |                     | V <sub>OH</sub>    | 2.4    | -     | -     | V     | I <sub>OH</sub> =-1mA          |

## 【Note1】

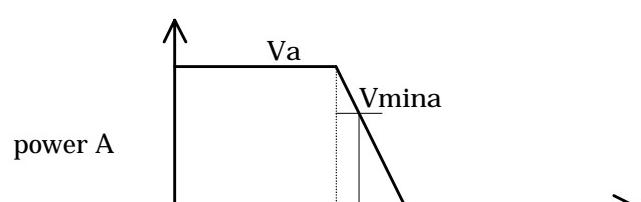
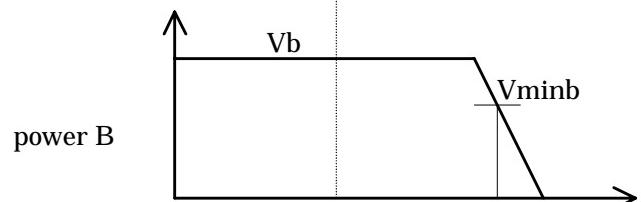
## 1 ) On sequence of two power supplies

(sequence free)

The case of ( V<sub>a</sub>, V<sub>b</sub> ) = ( V<sub>cc</sub>, V<sub>dd</sub> )( V<sub>mina</sub>, V<sub>minb</sub> ) = ( 4.75V, 14.0V )The case of ( V<sub>a</sub>, V<sub>b</sub> ) = ( V<sub>dd</sub>, V<sub>cc</sub> )( V<sub>mina</sub>, V<sub>minb</sub> ) = ( 14.0V, 4.75 V )

The LCD module turns on when (power A V<sub>mina</sub>) and (power B V<sub>minb</sub>).

## 2 ) Off sequence of two power supplies

The case of ( V<sub>a</sub>, V<sub>b</sub> ) = ( V<sub>cc</sub>, V<sub>dd</sub> )( V<sub>mina</sub>, V<sub>minb</sub> ) = ( 4.75V, 14.0V )The case of ( V<sub>a</sub>, V<sub>b</sub> ) = ( V<sub>dd</sub>, V<sub>cc</sub> )( V<sub>mina</sub>, V<sub>minb</sub> ) = ( 14.0V, 4.75V )

The LCD module shuts down when (power A V<sub>mina</sub>) or (power B V<sub>minb</sub>).

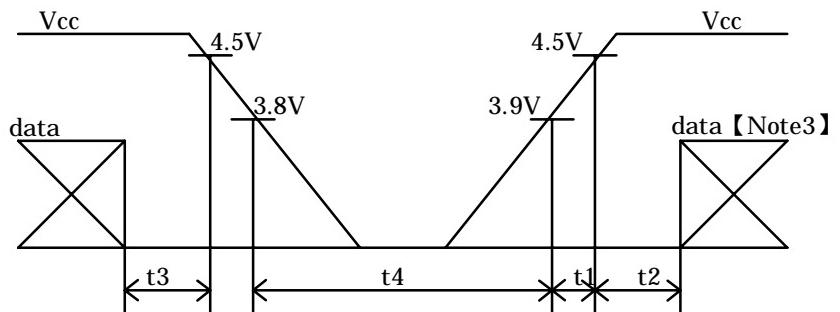
## 3 ) On-off sequences of Vcc and data

0 &lt; t1 10ms

0 &lt; t2 10ms

0 t3 10ms

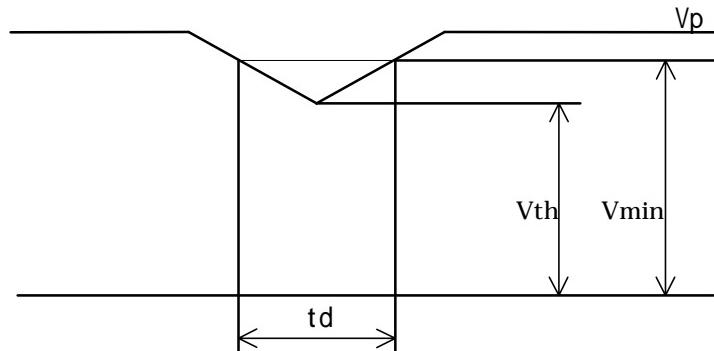
t4 1s



## 4 ) Dip conditions for supply voltage

The case of  $V_p = V_{cc}$  $(V_{min}, V_{th}) = (4.75V, 3.8V)$ 1)  $3.8V \leq V_{cc} < 4.75V$  $t_d \geq 10ms$ 2)  $V_{cc} < 3.8V$ 

This case is described below \*1.

The case of  $V_p = V_{dd}$  $(V_{min}, V_{th}) = (14.0V, 4.2V)$ 1)  $4.2V \leq V_{dd} < 14.0V$  $t_d \geq 10ms$ 2)  $V_{dd} < 4.2V$ \*1 The LCD module shuts down when  $(V_{cc} < V_{th})$  or  $(V_{dd} < V_{th})$ .If they ( $V_{cc}, V_{dd}$ ) recover, the LCD module turns on following the 2 power sequence.

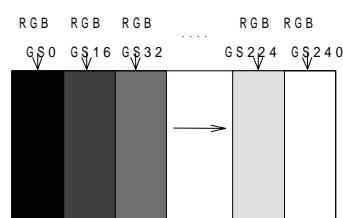
## 【Note2】 Typical current situation : 16-gray-bar pattern

 $V_{cc}=+5.0V, V_{dd}=+15.0V$ 

Gray scale : GS(16N)

 $N=0 \sim 15$ 

The explanation of each gray scale ,GS(16n), is described below section 8.



## 【Note3】 CLKA, CLKB, RA0 ~ RA7, GA0 ~ GA7, BA0 ~ BA7, RB0 ~ RB7, GB0 ~ GB7, BB0 ~ BB7,

RC0 ~ RC7, GC0 ~ GC7, BC0 ~ BC7, RD0 ~ RD7, GD0 ~ GD7, BD0 ~ BD7, DEA, DEB, MODE

## 6-2. Back light driving

The back light system is an edge-lighting type with four CCFTs (Cold Cathode Fluorescent Tube). The characteristics of the lamp are shown in the following table. The value mentioned below is at the case of one CCFT.

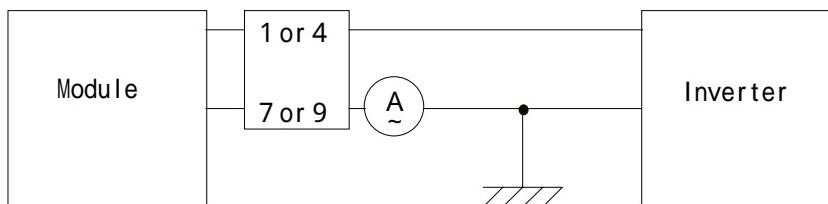
| Parameter              | Symbol | Min.  | Typ. | Max. | Unit  | Remark        |
|------------------------|--------|-------|------|------|-------|---------------|
| Lamp current range     | $I_L$  | -     | 6.5  | 7.5  | mArms | 【Note1】       |
| Lamp voltage           | $V_L$  | -     | 715  | -    | Vrms  | Ta=25         |
| Lamp power consumption | $P_L$  | -     | 4.65 | -    | W     | 【Note2】       |
| Lamp frequency         | $f_L$  | 50    | 60   | 70   | KHz   | 【Note3】       |
| Kick-off voltage       | $V_s$  | -     | -    | 1250 | Vrms  | Ta=25 【Note4】 |
|                        |        | -     | -    | 1600 | Vrms  | Ta=0 【Note4】  |
| Lamp life time         | $T_L$  | 50000 | -    | -    | hour  | 【Note5】       |

【Note1】 A lamp can be light in the range of lamp current shown above.

Maximum rating for current is measured by high frequency current measurement equipment connected to  $V_{LOW}$  at circuit showed below. (Note : To keep enough kick-off voltage and necessary steady voltage for CCFT.)

Lamp frequency : 50 ~ 70kHz

Ambient temperature : 0 ~ 50



\* 7 , 9 pin is  $V_{LOW}$

【Note2】 Referential data per one CCFT by calculation ( $I_L \times V_L$ ).

The data don't include loss at inverter.

【Note3】 Lamp frequency may produce interference with horizontal synchronous frequency, and this may cause beat on the display. Therefore lamp frequency shall be detached as much as possible from the horizontal synchronous frequency and from the harmonics of horizontal synchronous to avoid interference.

【Note4】 The voltage above this value should be applied to the lamp for more than 1 second to startup. Otherwise the lamp may not be turned on.

【Note5】 Lamp life time is defined as the time when either      or      occurs in the continuous operation under the condition of Ta=25      and  $I_L=6.5$  mArms.

Brightness becomes 50% of the original value under standard condition.

Kick-off voltage at Ta=0      exceeds maximum value, 1600 Vrms.

《Note》 The performance of the back light, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the back light and the inverter (miss-lighting, flicker, etc.) never occurs. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

## 7. Timing characteristics of input signals

### 7-1-1. 2pixel mode timing characteristics

Timing diagrams of input signal are shown in Fig.2.

| Parameter          |                          | Symbol | Min. | Typ. | Max. | Unit  | Remark  |
|--------------------|--------------------------|--------|------|------|------|-------|---------|
| Clock              | Frequency                | 1/Tc   | 34   | 55   | 60   | MHz   | 【Note1】 |
|                    | High time                | Tch    | 4    | -    | -    | ns    |         |
|                    | Low time                 | Tcl    | 4    | -    | -    | ns    |         |
|                    | Skew                     | Tcsq   | -1   | 0    | 1    | clock |         |
| Data               | Setup time               | Tds    | 3    | -    | -    | ns    |         |
|                    | Hold time                | Tdh    | 4    | -    | -    | ns    |         |
| Data enable signal | Setup time               | Tes    | 3    | -    | -    | ns    |         |
|                    | Hold time                | Teh    | 5    | -    | -    | ns    |         |
|                    | Horizontal period        | TH     | 668  | 848  | 928  | clock |         |
|                    |                          |        | 12.5 | 15   | -    | μs    |         |
|                    | Horizontal period (High) | THd    | 640  | 640  | 640  | clock |         |
|                    | Vertical period          | TV     | 1026 | 1066 | 1080 | line  | 【Note2】 |
|                    | Vertical period (High)   | TVd    | 1024 | 1024 | 1024 | line  |         |

【Note1】 Two pixel-data are sampled at the same time.

【Note2】 In case of using the long vertical period, the deterioration of display quality, flicker etc. may occur.

There should be integral horizontal period per one vertical period.

### 7-1-2. 4pixel mode timing characteristics

Timing diagrams of input signal are shown in Fig.3.

| Parameter          |                          | Symbol | Min. | Typ. | Max. | Unit  | Remark  |
|--------------------|--------------------------|--------|------|------|------|-------|---------|
| Clock              | Frequency                | 1/Tc   | 17   | 22.5 | 30   | MHz   | 【Note3】 |
|                    | High time                | Tch    | 4    | -    | -    | ns    |         |
|                    | Low time                 | Tcl    | 4    | -    | -    | ns    |         |
|                    | Skew                     | Tcsq   | -1   | 0    | 1    | clock |         |
| Data               | Setup time               | Tds    | 3    | -    | -    | ns    |         |
|                    | Hold time                | Tdh    | 4    | -    | -    | ns    |         |
| Data enable signal | Setup time               | Tes    | 3    | -    | -    | ns    |         |
|                    | Hold time                | Teh    | 5    | -    | -    | ns    |         |
|                    | Horizontal period        | TH     | 334  | 424  | 464  | clock |         |
|                    |                          |        | 12.5 | 15   | -    | μs    |         |
|                    | Horizontal period (High) | THd    | 320  | 320  | 320  | clock |         |
|                    | Vertical period          | TV     | 1026 | 1066 | 1080 | line  | 【Note4】 |
|                    | Vertical period (High)   | TVd    | 1024 | 1024 | 1024 | line  |         |

【Note3】 Four pixel-data are sampled at the same time.

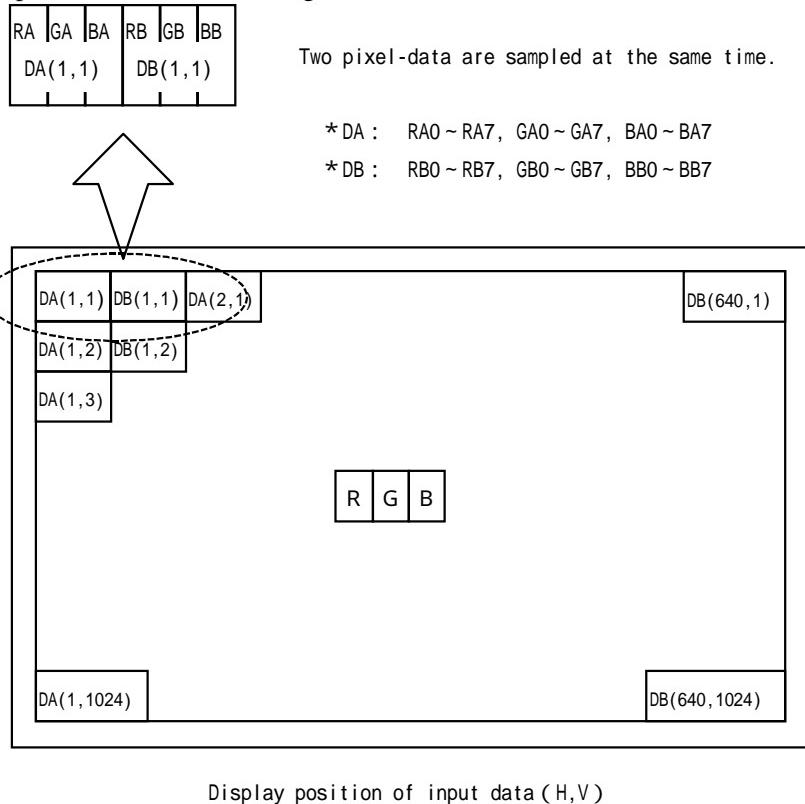
【Note4】 In case of using the long vertical period, the deterioration of display quality, flicker etc. may occur.

There should be integral horizontal period per one vertical period.

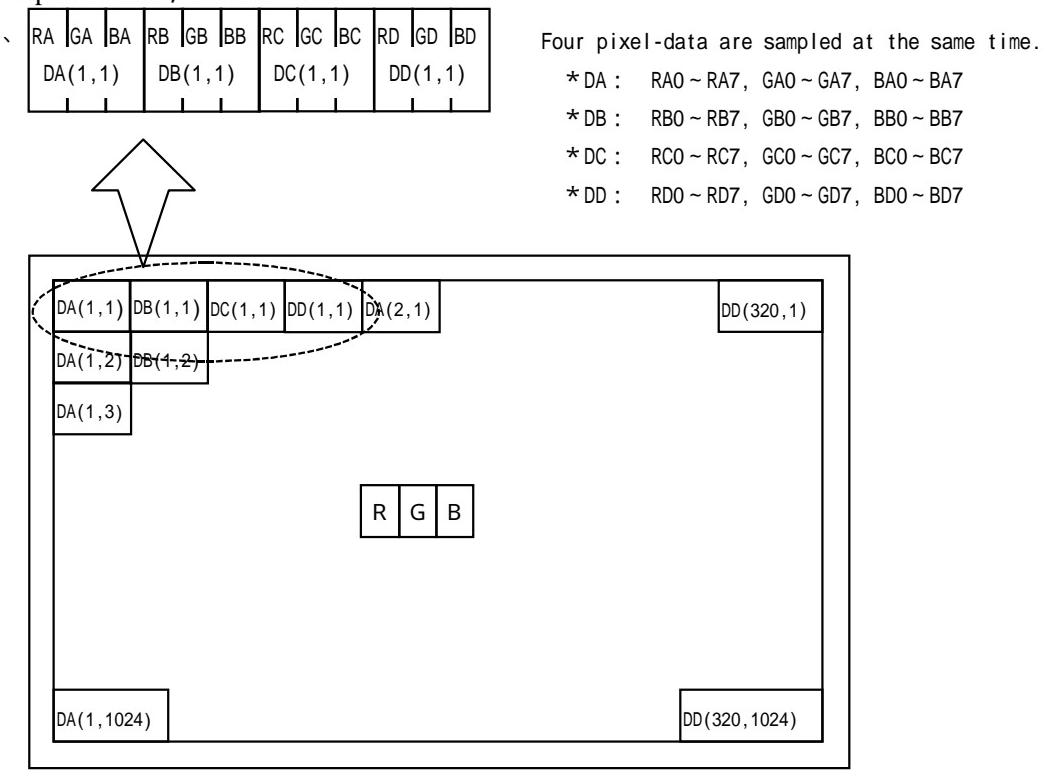
## 7-2 Input Data Signals and Display Position on the screen

Graphics and texts can be displayed on a 1280 × 3 × 1024 dots panel with 16M colors by supplying 48 / 96 bit data signal (8bit/color [256 gray scale] × 3 × 2 pixels / 4pixels).

### 7-2-1 2 pixel mode ; MODE="high"



### 7-2-2 4 pixel mode ; MODE="low"



## 8. Input Signals, Basic Display Colors and Gray Scale of Each Color

| Colors & Gray scale |  | Data signal                     |       |   |   |   |   |   |                                 |   |   |   |   |   |   |                                 |   |   |   |   |   |   |   |   |   |   |
|---------------------|--|---------------------------------|-------|---|---|---|---|---|---------------------------------|---|---|---|---|---|---|---------------------------------|---|---|---|---|---|---|---|---|---|---|
|                     |  | RA0 RA1 RA2 RA3 RA4 RA5 RA6 RA7 |       |   |   |   |   |   | GA0 GA1 GA2 GA3 GA4 GA5 GA6 GA7 |   |   |   |   |   |   | BA0 BA1 BA2 BA3 BA4 BA5 BA6 BA7 |   |   |   |   |   |   |   |   |   |   |
|                     |  | RB0 RB1 RB2 RB3 RB4 RB5 RB6 RB7 |       |   |   |   |   |   | GB0 GB1 GB2 GB3 GB4 GB5 GB6 GB7 |   |   |   |   |   |   | BB0 BB1 BB2 BB3 BB4 BB5 BB6 BB7 |   |   |   |   |   |   |   |   |   |   |
|                     |  | RC0 RC1 RC2 RC3 RC4 RC5 RC6 RC7 |       |   |   |   |   |   | GC0 GC1 GC2 GC3 GC4 GC5 GC6 GC7 |   |   |   |   |   |   | BC0 BC1 BC2 BC3 BC4 BC5 BC6 BC7 |   |   |   |   |   |   |   |   |   |   |
| Basic Color         |  | RD0 RD1 RD2 RD3 RD4 RD5 RD6 RD7 |       |   |   |   |   |   | GD0 GD1 GD2 GD3 GD4 GD5 GD6 GD7 |   |   |   |   |   |   | BD0 BD1 BD2 BD3 BD4 BD5 BD6 BD7 |   |   |   |   |   |   |   |   |   |   |
|                     |  | Black                           | -     | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |
|                     |  | Blue                            | -     | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |   |
|                     |  | Green                           | -     | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | Cyan                            | -     | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |   |
|                     |  | Red                             | -     | 1 | 1 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | Magenta                         | -     | 1 | 1 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |   |
|                     |  | Yellow                          | -     | 1 | 1 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 1 | 1 | 1 | 1                               | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | White                           | -     | 1 | 1 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |   |
| Gray Scale of Red   |  | Black                           | GS0   | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | Darker                          | GS1   | 1 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  |                                 | GS2   | 0 | 1 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | Brighter                        | ↓     | ↓ |   |   |   |   |                                 |   | ↓ |   |   |   |   |                                 |   | ↓ |   |   |   |   |   |   |   |   |
|                     |  |                                 | GS250 | 1 | 0 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | Red                             | GS251 | 0 | 1 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  |                                 | GS252 | 1 | 1 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| Gray Scale of Green |  | Black                           | GS0   | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|                     |  | Darker                          | GS1   | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 1 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  |                                 | GS2   | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 1 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | Brighter                        | ↓     | ↓ |   |   |   |   |                                 |   | ↓ |   |   |   |   |                                 |   | ↓ |   |   |   |   |   |   |   |   |
|                     |  |                                 | GS250 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 1 | 0 | 1 | 1 | 1                               | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | Green                           | GS251 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 1 | 1 | 1                               | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  |                                 | GS252 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 1 | 1 | 1 | 1                               | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |   |
| Gray Scale of Blue  |  | Black                           | GS0   | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | Darker                          | GS1   | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  |                                 | GS2   | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |   |
|                     |  | Brighter                        | ↓     | ↓ |   |   |   |   |                                 |   | ↓ |   |   |   |   |                                 |   | ↓ |   |   |   |   |   |   |   |   |
|                     |  |                                 | GS250 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |   |
|                     |  | Blue                            | GS251 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |   |
|                     |  |                                 | GS252 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 0 | 0 | 0 | 0                               | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |   |

0 : Low level voltage, 1 : High level voltage.

Each basic color can be displayed in 256 gray scales from 8 bit data signals. According to the combination of total 24 bit data signals, the 16-million-color display can be achieved on the screen.

## 9. Optical Characteristics

Ta=25°C, Vcc=+5V, Vdd=+15V

| Parameter             |                | Symbol | Condition     | Min.  | Typ.  | Max.  | Unit              | Remark                     |
|-----------------------|----------------|--------|---------------|-------|-------|-------|-------------------|----------------------------|
| Viewing Angle range   | Vertical       | 11     | CR 10<br>=0 ° | 70    | 85    | -     | Deg.              | 【Note1,4】                  |
|                       |                | 12     |               | 70    | 85    | -     | Deg               |                            |
|                       | Horizontal     | 21, 22 |               | 70    | 85    | -     | Deg.              |                            |
| Contrast ratio        |                | C R    | =0 °          | -     | 350   | -     |                   | 【Note2,4】                  |
| Response Time         | Rise           | r      |               | -     | 5     | -     | ms                | 【Note3,4】                  |
|                       | Decay          | d      |               | -     | 20    | -     | ms                |                            |
| Chromaticity of white | Wx             |        |               | 0.278 | 0.308 | 0.338 | -                 | 【Note4】                    |
|                       | Wy             |        |               | 0.290 | 0.320 | 0.350 | -                 |                            |
| Chromaticity of red   | Rx             |        |               | 0.577 | 0.607 | 0.637 | -                 |                            |
|                       | Ry             |        |               | 0.309 | 0.339 | 0.369 | -                 |                            |
| Chromaticity of green | Gx             |        |               | 0.257 | 0.287 | 0.317 | -                 |                            |
|                       | Gy             |        |               | 0.567 | 0.597 | 0.627 | -                 |                            |
| Chromaticity of blue  | Bx             |        |               | 0.115 | 0.145 | 0.175 | -                 |                            |
|                       | By             |        |               | 0.057 | 0.087 | 0.117 | -                 |                            |
| Luminance of white    | Y <sub>L</sub> |        |               | 150   | 200   | -     | cd/m <sup>2</sup> | IL=6.5mA rms<br>FL = 60KHz |
| White Uniformity      | w              |        |               | -     | -     | 1.25  | -                 | 【Note5】                    |

The measurement shall be executed 30 minutes after lighting at rating.

The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.4 below.

【Note1】 Definitions of viewing angle range:

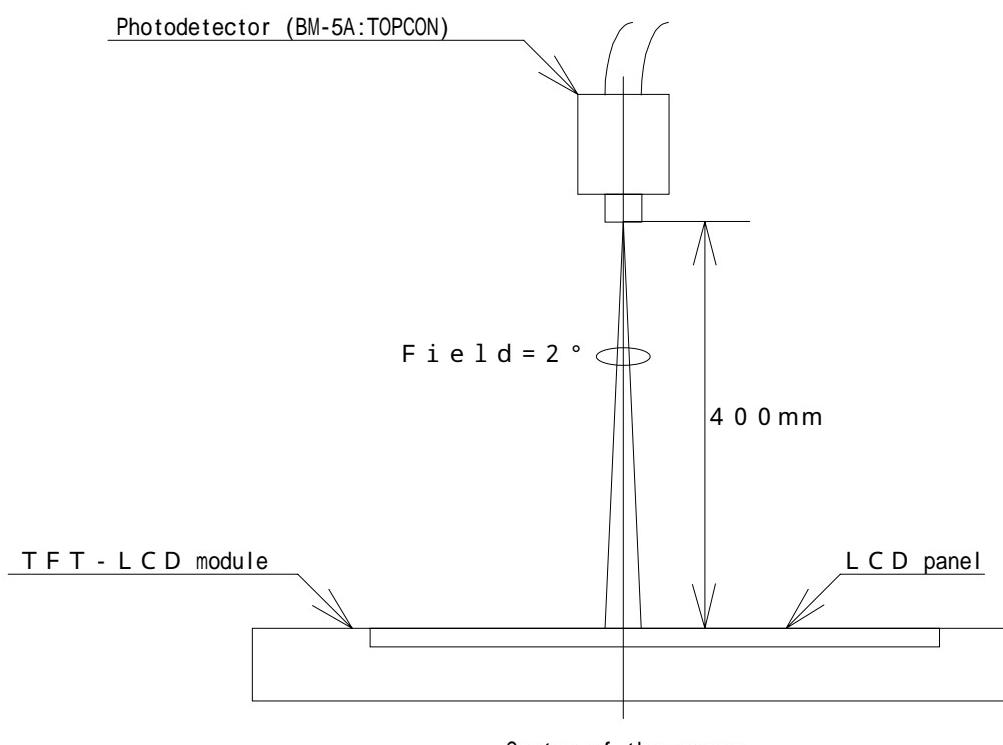
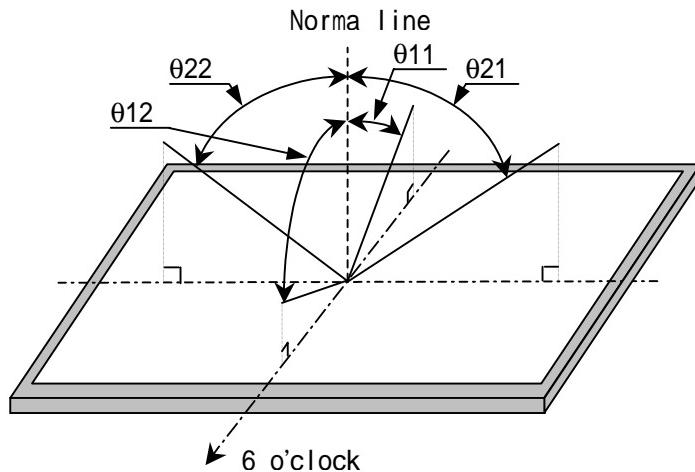


Fig.4 Optical characteristics measurement method



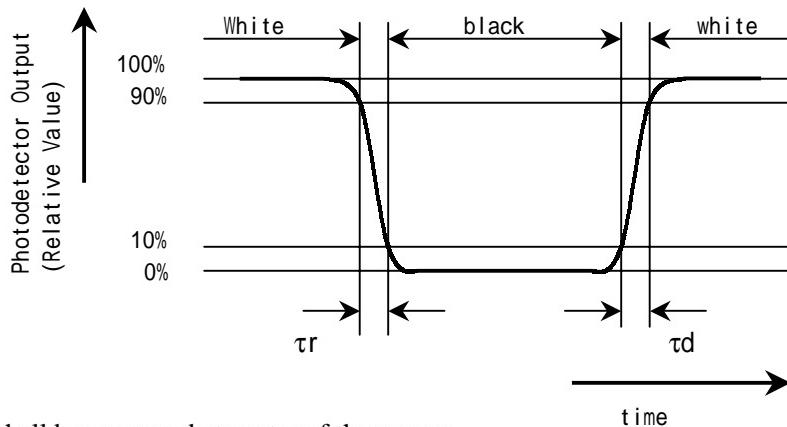
**【Note2】** Definition of contrast ratio:

The contrast ratio is defined as the following.

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

**【Note3】** Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

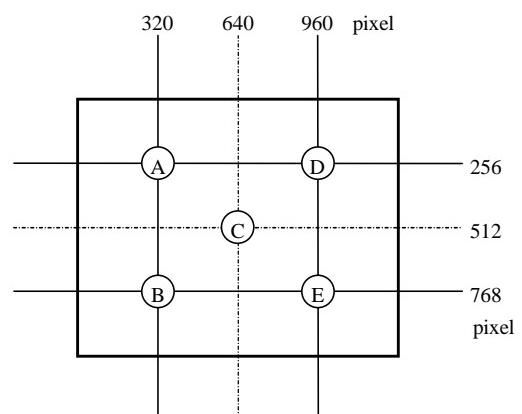


**【Note4】** This shall be measured at center of the screen.

**【Note5】** Definition of white uniformity:

White uniformity is defined as the following with five measurements (A ~ E).

$$W = \frac{\text{Maximum Luminance of five points (brightness)}}{\text{Minimum Luminance of five points (brightness)}}$$



## 10. Handling Precautions

- a) Be sure to turn off the power supply when inserting or disconnecting the cable.
- b) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.
- c) Since the front polarize is easily damaged, pay attention not to scratch it.
- d) Since long contact with water may cause discoloration or spots, wipe off water drop immediately.
- e) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.
- g) Since CMOS LSI is used in this module, take care of static electricity and take the human earth into consideration when handling.
- h) Make sure the four mounting holes of the module are grounded sufficiently. Take electro-magnetic interference (EMI) into consideration.
- i) The module has some printed circuit boards (PCBs) on the back side. Take care to keep them from any stress or pressure when handling or installing the module; otherwise some of electronic parts on the PCBs may be damaged.
- j) Observe all other precautionary requirements in handling components.
- k) When some pressure is added onto the module from rear side constantly, it causes display non-uniformity issue , functional defect, etc. So, please avoid such design.
- l) When giving a touch to the panel at power supply, it may cause some kinds of degradation. In that case, once turn off the power supply, and turn on after several seconds again, and that is disappear.

## 11. Packing form

- a) Piling number of cartons : maximum 12 cartons
- b) Packing quantity in one carton : 1 module
- c) Carton size : 585mm(W) × 506mm(H) × 120mm(D)
- d) Total mass of one carton filled with full modules : 5kg

## 12 . Reliability test items

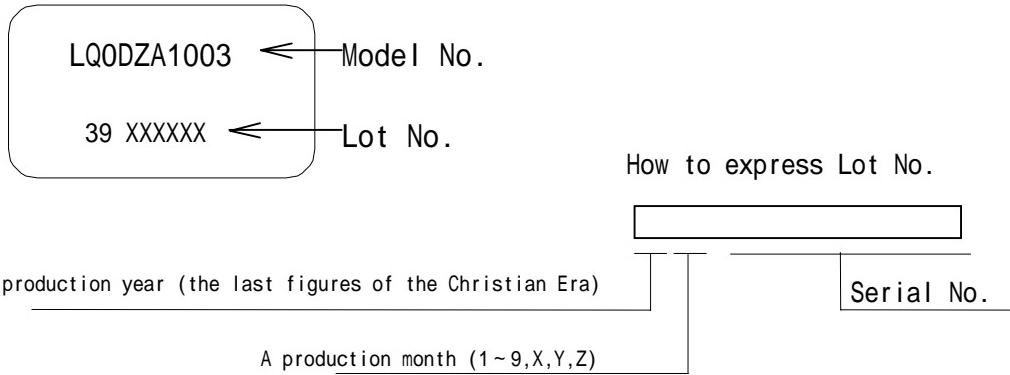
| No. | Test item                                       | Conditions   |
|-----|---|--|
| 1   | High temperature storage test                   | Ta=60 240h   |
| 2   | Low temperature storage test                    | Ta=-25 240h  |
| 3   | High temperature & high humidity operation test | Ta=40 ; 95%RH 240h<br>(No condensation)  |
| 4   | High temperature operation test                 | Ta=50 240h<br>(The panel temp. must be less than 60 )  |
| 5   | Low temperature operation test                  | Ta=0 240H  |
| 6   | Vibration test (non- operating)                 | Frequency : 10 ~ 57Hz/Vibration width (one side) : 0.075mm : 58 ~ 500Hz/Gravity : 9.8m/s <sup>2</sup><br>Sweep time : 11minutes<br>Test period : 3 hours<br>(1 hour for each direction of X,Y,Z) |
| 7   | Shock test (non- operating)                     | Max. gravity : 490m/s <sup>2</sup><br>Pulse width : 11ms, sine wave<br>Direction : ± X, ± Y, ± Z,<br>once for each direction.  |

## 【Result Evaluation Criteria】

Under the display quality test conditions with normal operation state, these shall be no change which may affect practical display function.

## 13 . Others

## 1) Lot No. and indication Label:



- 2) Adjusting volume have been set optimally before shipment, so do not change any adjusted value.  
If adjusted value is changed, the specification may not be satisfied.
- 3) Disassembling the module can cause permanent damage and should be strictly avoided.
- 4) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.
- 5) The chemical compound which causes the destruction of ozone layer is not being used.
- 6) Material information of LPG(Light Pipe Guide) are labeled on the back of the module.

|                            |
|----------------------------|
| MATERIAL INFORMATION       |
| >PLASTIC LIGHT GUIDE:PMMA< |

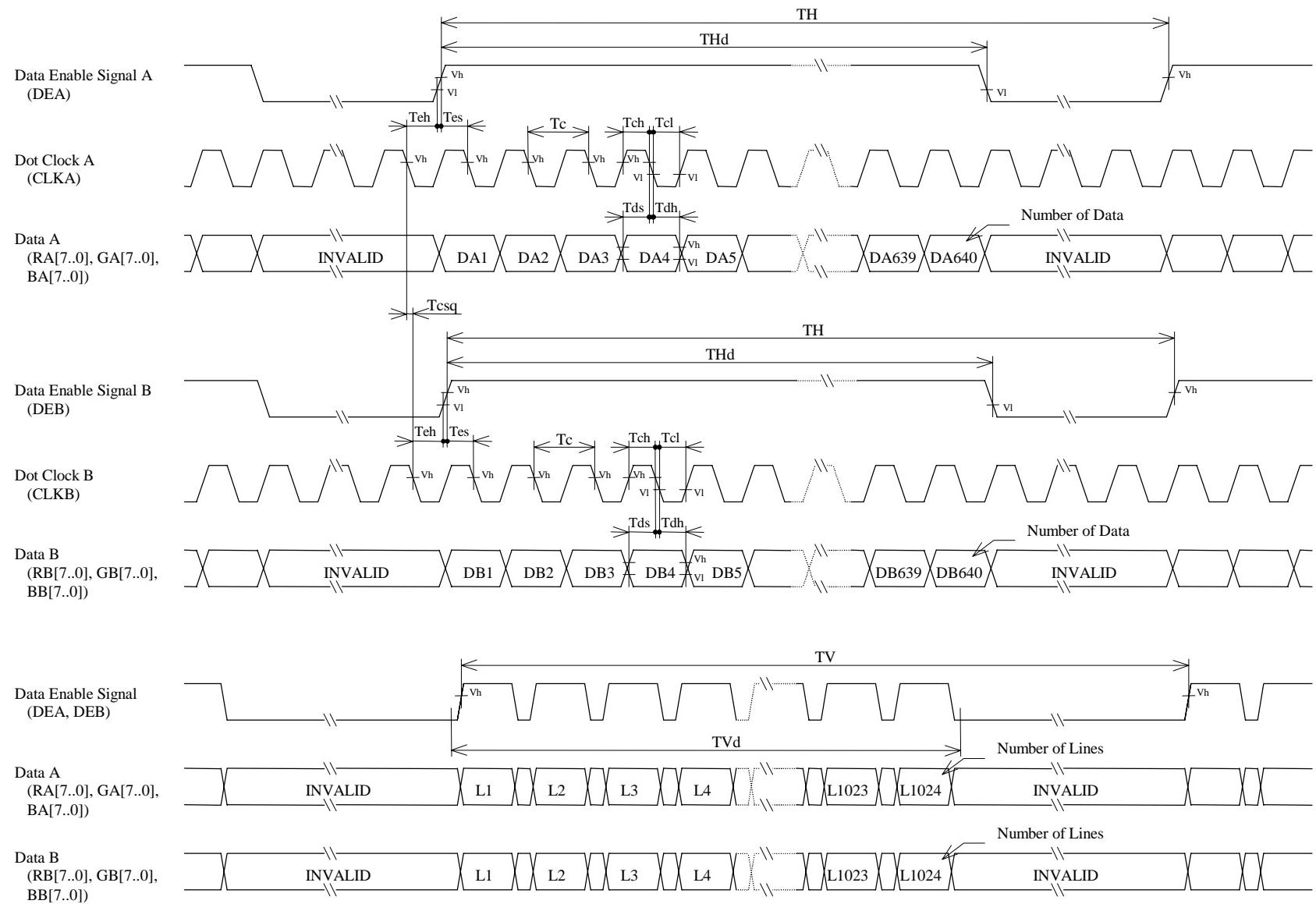


Fig. 2 2-pixel mode

Note : The following signal pins must be connected to the GND :

RC[7..0], GC[7..0], BC[7..0], RD[7..0], GD[7..0], BD[7..0]

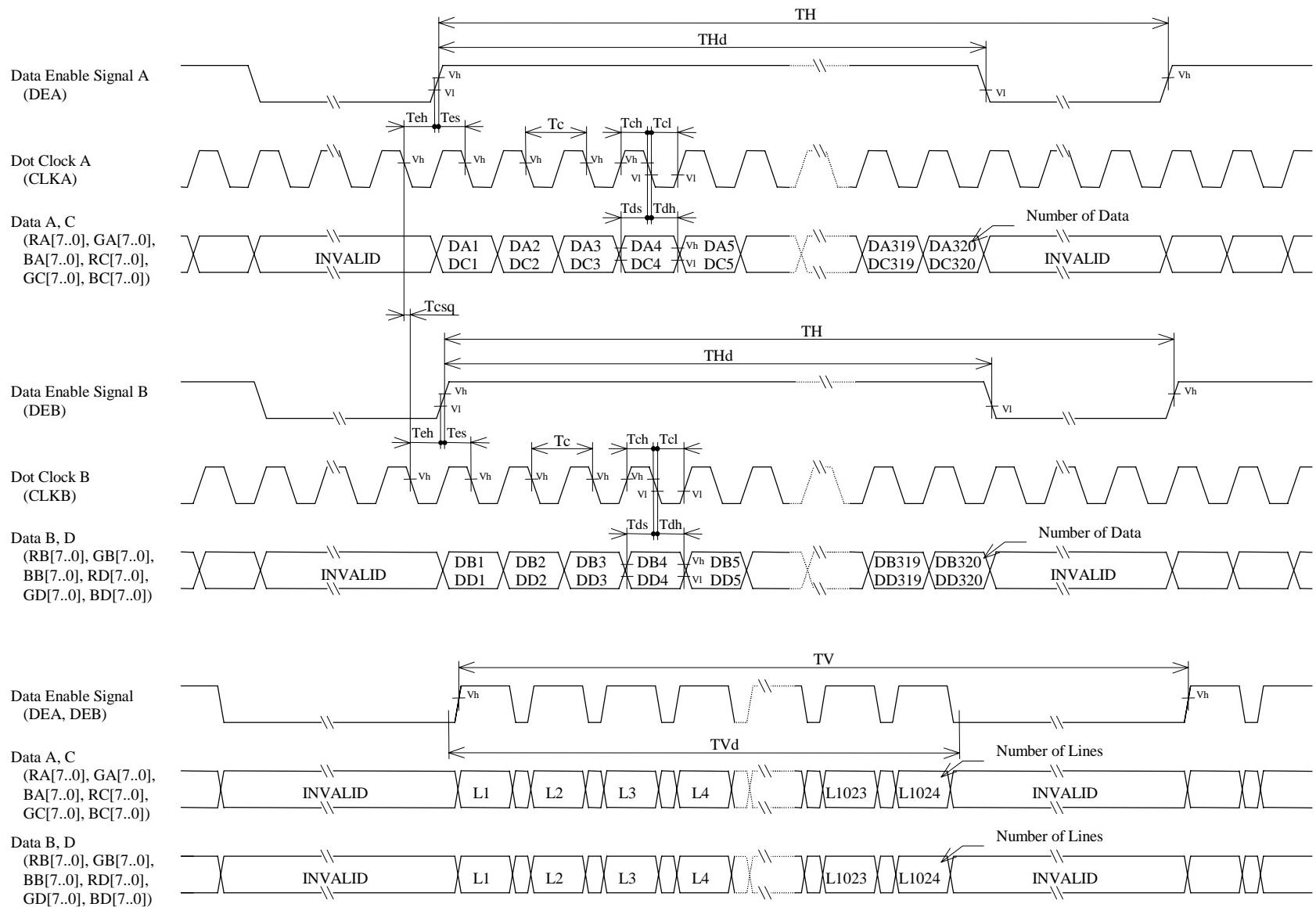


Fig. 3 4-pixel mode

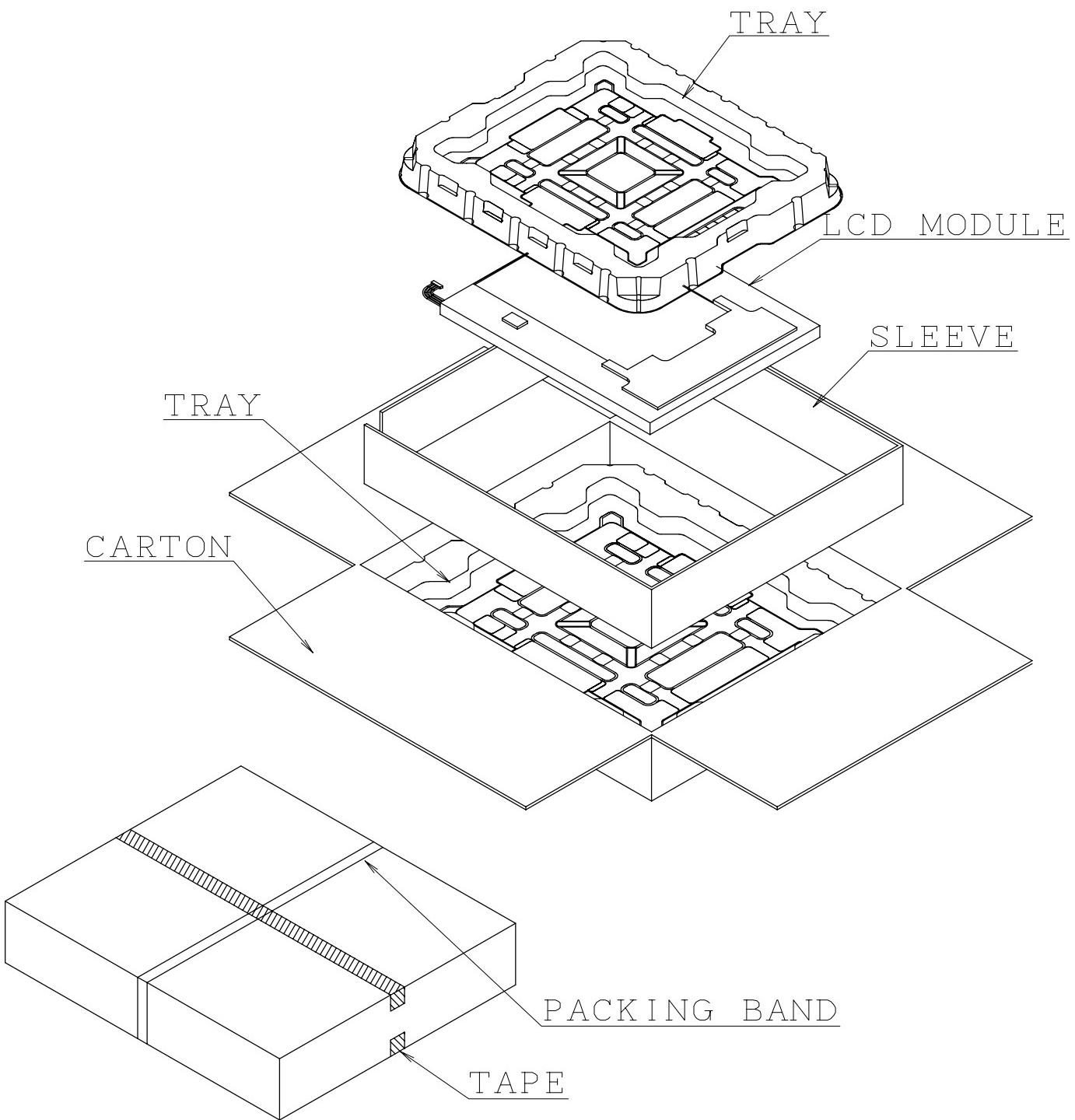
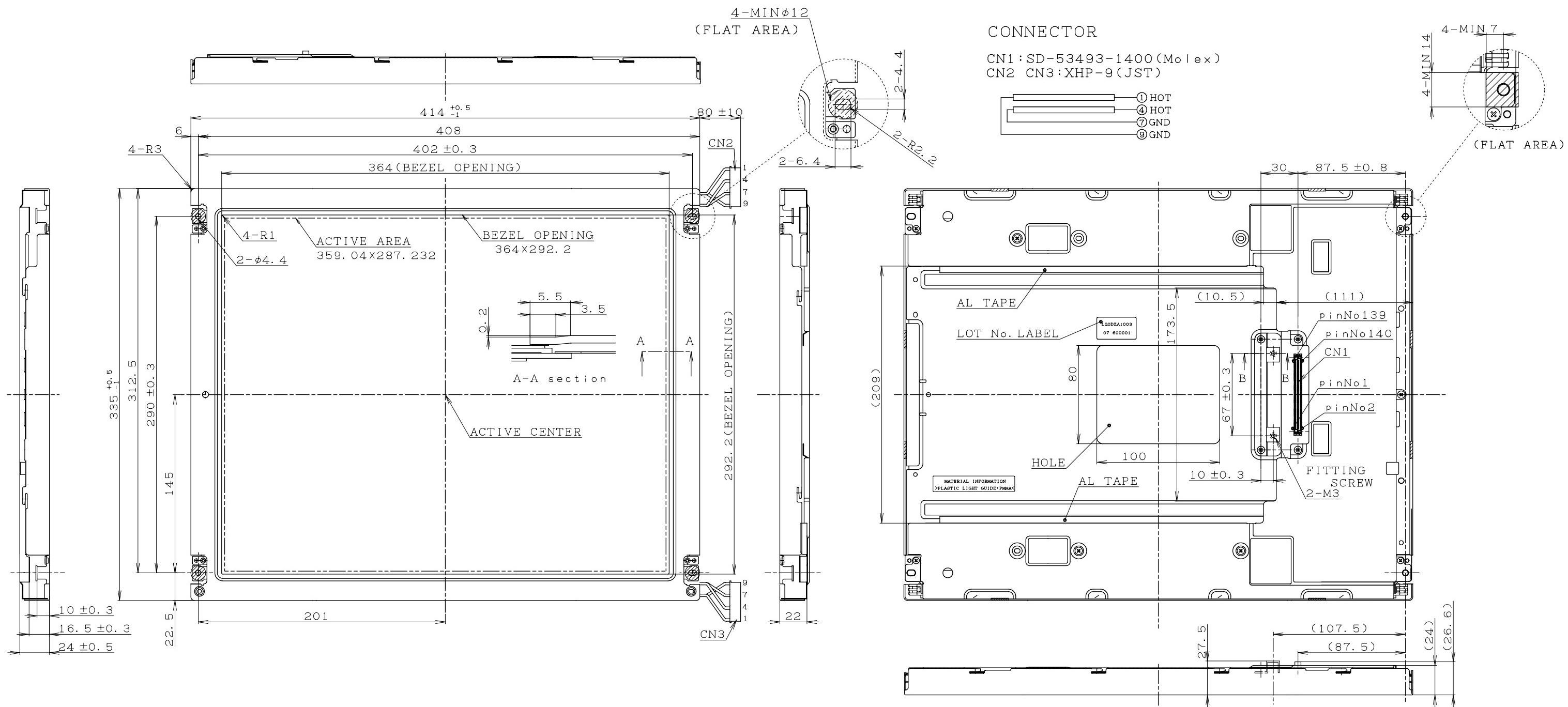
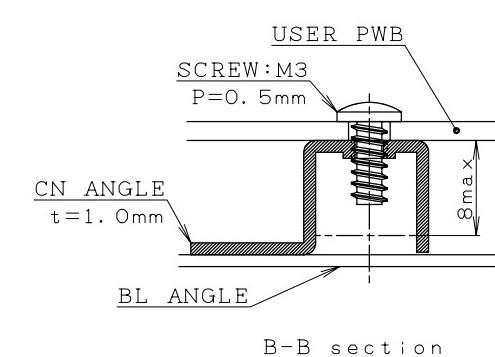


Fig. 5 PACKING FORM

**NOTES**

1. UNSPECIFIED TOLERANCE TO BE  $\pm 0.8$
2. WARP AND FLATING FOR BEZEL AND REARCASE ETC.  
ARE EXCLUDED FROM  
THICKNESS AND DIMENSION OF THE UNIT.



1) TOLERANCE X-DIRECTION A:  $2.5 \pm 0.8$   
2) TOLERANCE Y-DIRECTION B:  $2.5 \pm 0.8$   
3) OBLIQUITY OF DISPLAY AREA IC-D < 0.8

**OUTLINE DIMENSIONS**